United States Department of Agriculture
Animal and Plant Health Inspection Service
Plant Protection and Quarantine

Importation of Chinese Penjing

into the United States

With Particular Reference to *Serissa foetida*

2003 Supplementary Assessment

Gary L. Cave, Ph.D., Entomologist
Eileen Sutker, Ph.D., Ecologist

United States Department of Agriculture
Animal and Plant Health Inspection Service
Plant Protection and Quarantine
Center for Plant Health Science and Technology
Plant Epidemiology and Risk Analysis Laboratory
1017 Main Campus Dr., Suite 1550
Raleigh, NC 27606

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Executive Summary

This pathway-initiated commodity risk assessment examines the risks associated with the proposed importation of penjing plants of *Serissa foetida*, in approved growing media, from the People's Republic of China into the United States. The quarantine pests that are likely to follow the pathway are analyzed using the methodology described in the USDA, APHIS, PPQ Guidelines 5.02 which examines pest biology in the context of the Consequences of Introduction and the Likelihood of Introduction and estimates the Pest Risk Potential. The quarantine pests that can potentially follow the pathway on these plants includes three arthropods, two mollusks, two fungi and three nematodes. The Pest Risk Potential is rated for each of the organisms and is summarized in the table below.

Pest	Pest Risk Potential
ARTHROPODA	
Sympiezomias velatus Chevrolet (Coleoptera: Curculionidae)	High (28)
Rhizoecus hibisci Kawai & Takagi (Homoptera: Pseudococcidae)	High (28)
Thrips palmi Karny (Thysanoptera: Thripidae)	Medium (26)
MOLLUSCA	
Sarasinula plebeia (Fischer) (Veronicellidae)	High (30)
Succinea horticola Reinhart (Succineidae)	High (30)
FUNGI	
Melampsora serissicola Shang, Li & Wang (Basidiomycetes, Uredinales)	Medium (21)
Phomopsis sp. (Fungi Imperfecti, Coelomycetes)	High (27)
NEMATODA	
Xiphinema brasiliense Lordello (Xiphinematidae)	Medium (23)
Tylenchorhynchus crassicaudatus Williams (Belonolaimidae)	Medium (25)
Tylenchorhynchus leviterminalis Siddiqi, Mukherjee & Dasgupta (Belonolaimidae)	Medium (25)

In this document, a number of exotic, polyphagous pests intercepted in Europe on unspecified Abonsai@ plants are assumed to be potential pests of *Serissa foetida* (EPPO, 1996a, 1996b). The following pests, analyzed in 1996 using the PPQ Guidelines version 4.0 criteria and then current literature, are now not considered likely to follow the pathway of the importation based on a reexamination of their reported host ranges: *Adoretus sinicus*, *Agrotis segetum*, *Amphimallon solstitialis*, *Anomala corpulenta*, *A. cupripes*, *Aporia crataegi*, *Chrysodeixis chalcites*, *Conogethes punctiferalis*, *Drosicha corpulenta*, *Gryllotalpa orientalis*, *Lepidosaphes laterochitinosa*, *Mamestra brassicae*, *Phyllophaga titanis*, *Spodoptera litura*, and *Tridactylus japonicus* (China, 1995). Similarly, *Cnidocampa flavescens*, present in the United States, is not analyzed.

The accompanying pest risk management document considers the reduction of risk that will occur when existing regulations on the importation of plants in APHIS-approved growing media (7 CFR ' 319.37-8) and proposed additional mitigation measures are applied to the importation of *Serissa foetida* penjing plants in growing media from the People's Republic of China. The safeguards will effectively remove the pests of concern from the pathway and allow the importation of these plants to be associated with no more pest risk than is associated with currently permitted bare-root importations.

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I. Introduction

This pest risk assessment (PRA) was conducted by the United States Department of Agriculture, Animal and Plant Health Inspection Service, Plant Protection and Quarantine, Center for Plant Health Science and Technology, Plant Epidemiology and Risk Analysis Laboratory (USDA, APHIS, PPQ, CPHST, PERAL) to examine the plant pest risks associated with the importation of artificially dwarfed plants of *Serissa foetida* established in an APHIS-approved growing medium from the People's Republic of China into the United States. The purpose of this document is to update an earlier version (Cave and Redlin, 1996).

The art of artificially dwarfing plants is a time-consuming and highly labor-intensive activity. The resulting plants range from approximately four inches to 60 inches in height, and the value may range from $10 to $10,000 per plant. The median price of an artificially dwarfed plant is close to $100 and varies with the age of the plant regardless of size. Plants imported from Asia (Japan, the People's Republic of China and the Republic of Korea) represent approximately 80 percent of the value of the entire artificially dwarfed plant market in the United States [Importation of Artificially Dwarfed Plants in Growing Media From the People's Republic of China, 65 Fed. Reg. 56803-56806 (2000) (as proposed Sept. 20, 2000) (Docket Number: 98-103-1)].

Authority for APHIS to regulate plant pests/plant products is derived from the Plant Protection Act of 2000 (7 USC §§ 7701 *et seq*.) and the Code of Federal Regulations, Title 7, Part 319, Subpart 37 (7 CFR § 319.37 - Nursery Stock, Plants, Roots, Bulbs, Seeds and Other Plant Products). The risk assessment methodology and rating criteria and the use of biological and phytosanitary terms is consistent with international guidelines (FAO, 2001, 2002; NAPPO, 1995) and current agency guidelines (APHIS, 2000).

II. Risk Assessment

A. Initiating Event: Proposed Action

This commodity-based, pathway-initiated pest risk assessment is prepared in response to a request from the Chinese Animal and Plant Quarantine Service (ASIQ) to change current regulations to allow increased types of importations of artificially dwarfed penjing plants of *Serissa foetida* from China into the United States. This is a potential pathway for the introduction of plant pests. The entry of bare-root *S. foetida* from China into the United States is currently regulated under 7 CFR ' 319.37, and does not explicitly prohibit the importation of naturally dwarf plants under 305 millimeters in length or artificially dwarfed plants. This lack of restrictions allows such plants to enter the United States if the plants are accompanied by a phytosanitary certificate of inspection.

The USDA carefully assesses requests to change regulations related to propagative materials because the importation of propagative material in growing media raises unique phytosanitary concerns. Specifically, some biological contaminants may not be discernible during pre-shipment and Port of Entry visual inspections. This inability to non-destructively inspect may increase the potential for the introduction of some exotic organisms. Treatment of growing media may not rid the media of exotic organisms in the absence of specific guidelines, and the possibility of pest infestation/re-infestation of "clean" plants in the absence of specific safeguards exists.

During the past decade, China has exported significant volumes of bare-root bonsai plants into the United States under the existing regulations. In August 1992, representatives of the China Animal and Plant Quarantine Service (ASIQ) requested permission to export penjing plants established in APHIS-approved growing media. A list of 112 plant species was submitted. These plants were categorized by PPQ as Aprohibited@, Apost-entry quarantine@, and Arestricted@. In January 1994, ASIQ was asked to select five species for pest risk analysis. Subsequently, ASIQ submitted a list of eight species, and provided a list of pests or potential pests associated with these plants. In April 1994, PPQ staff identified five plant species as candidates for pest risk assessments: *Buxus sinica* (Buxaceae), *Ehretia* (*Carmona*) *microphylla* (Boraginaceae), *Podocarpus macrophyllus* (Podocarpaceae), *Sageretia thea* (*theazans)* (Rhamnaceae), and *Serissa foetida* (Rubiaceae). The risk assessment for *S. foetida* was completed in September 1996 using agency guidelines 4.0 (APHIS, 1995). A Proposed Rule was published in 65 Fed. Reg 183 (Docket Number 00-042-1) on September 20, 2000. Compliance with the Endangered Species Act necessitated PPQ consultation with the US Fish and Wildlife Service (USFWS). Additional documentation was provided separately to the USFWS. These documentary requirements created a need to re-examine and update the original risk assessment for *S. foetida*.

In this document, a number of exotic, polyphagous pests intercepted in Europe on unspecified Abonsai@ plants are assumed to be potential pests of *S. foetida* (EPPO, 1996a,b). The following pests, analyzed in 1996 using the PPQ Guidelines version 4.0 criteria and then current literature, are now not considered likely to follow the pathway of the importation based on a reexamination of their reported host ranges: *Adoretus sinicus*, *Agrotis segetum*, *Amphimallon solstitialis*, *Anomala corpulenta*, *A. cupripes, Aporia crataegi*, *Chrysodeixis chalcites, Conogethes punctiferalis, Drosicha corpulenta*, *Gryllotalpa orientalis, Lepidosaphes laterochitinosa, Mamestra brassicae, Phyllophaga titanis*, *Spodoptera litura*, and *Tridactylus japonicus* (China, 1995). Similarly, *Cnidocampa flavescens*, present in the United States, is not analyzed.

The volume of artificially dwarfed and other dwarf plants imported into the United States increased in recent years from fewer than 600 plants in 1993 to over 54,000 plants in 1998 [Importation of Artificially Dwarfed Plants in Growing Media from the People's Republic of China, 65 Fed. Reg. 56803-56806 (2000) (as proposed Sept. 20, 2000) (Docket Number: 98-103-1]. The Final Rule was designed to reduce the risks associated with field-collected plants that are produced quickly in their country of origin for mass export. [Importation of Artificially Dwarfed Plants 67 Fed. Reg. 53727-53731 (2002) (Docket No. 00-042-2]. These field-grown plants include species that, historically, were not imported as artificially dwarfed plants and that may not be given the same meticulous care and safeguards as traditional artificially dwarfed plants. Artificially dwarfed plants grown in fields prior to their 2-year greenhouse/screen-house growth period are required to be produced with specific safeguards to protect against infestation by longhorned beetles (Coleoptera: Cerambycidae).

B. Assessment of the Weed Potential of *Serissa foetida*

If the species considered for import poses a risk as a weed pest, then a "pest-initiated" risk assessment is conducted. The results of the screening for weed potential for *S. foetida* (Table 1) did not prompt a pest-initiated risk assessment because the evaluation concluded that there is not a significant weed potential for this species. For a number of years, this species has been imported as bare-root plants into the United States. These plants are not regularly grown outdoors or in unmanaged habitats because of their temperature and light requirements (Anon., 2003a; Anon., 2003b; NRCS, 2003) (Table 1).

Table 1. Weed Potential of *Serissa foetida*
Commodity: *Serissa foetida* (Rubiaceae) Phase 1: The genus *Serissa* consists of one (some botanists split it into three) species of cultivated ornamental shrub(s), native to southeast Asia. *Serissa foetida* (*S. japonica*) generally is grown indoors but may be cultivated as an ornamental in warm areas of the United States. There are 73 genera of this family including: *Coffea, Diodia, Galium, Gardenia, Hedyotis, Houstonia, Psychotria, Richardia* and *Spermacoce* (NRCS, 2003). Phase 2: Is the genus listed in: NO Geographical Atlas of World Weeds (Holm *et* al., 1979) NO World's Worst Weeds (Holm *et al*., 1977) or World Weeds: Natural Histories and Distribution (Holm *et al*., 1997) NO Report of the Technical Committee to Evaluate Noxious Weeds; Exotic Weeds for Federal Noxious Weed Act (Gunn and Ritchie, 1982) NO Economically Important Foreign Weeds (Reed, 1977) NO Weed Science Society of America list (WSSA, 1989) NO Is there any literature reference indicating weed potential, *e.g*. AGRICOLA, CAB Biological Abstracts, AGRIS; search on "*Serissa*" combined with "weed"). Phase 3: For a number of years *Serissa foetida* has been imported into the United States and is not reported as a weed. These plants are generally grown in indoor habitats and not outdoors because of their temperature and light requirements (Anon., 2003a; Anon., 2003b; NRCS, 2003).

C. Prior Risk Assessments, Current Status and Pest Interceptions

Currently, artificially dwarfed plants of *S. foetida* may be imported as bare-root plants (7 CFR § 319.37). The risk assessment for *S. foetida* in growing media was completed in September 1996. Endangered species concerns necessitated consultations with the U.S. Fish and Wildlife Service. Additional mitigation measures applicable to artificially dwarfed plants in growing media were promulgated in a Final Rule (67 Fed. Reg. 53727-53731 on April 19, 2002) developed in response to interceptions of beetles. All mitigation measures in 67 Fed. Reg. 53727-53731 (2002) apply to *S. foetida*. Interceptions of pests on bare-root *Serissa foetida* are summarized in Table 2.

Table 2. Pest interceptions on bare-root *Serissa foetida* from China from 1985 to 2003 in permit cargo. All interceptions occurred once in the indicated year unless otherwise noted.

Pest	Dates
Acarina sp.	2001 (twice)
Ascochyta sp.	2003
Colletotrichum sp.	2002
Coniothyrium sp.	1995 (twice)
Cyclocephala sp.	1988
Cytospora sp.	1995, 2003 (twice)
Diaporthe sp.	1997
Diaspididae, species of	1988
Didymella sp.	2000
Didymosphaeria sp.	1996
Diplodia sp.	2000
Frankliniella sp.	2001
Fusicoccum sp.	1994
Lepidosaphes laterchitinosa	1988
Leptosphaeria sp.	1995, 2001
Lonchaeidae, species of	1997
Microsphaeropsis sp.	1995 (5 times), 1996, 1997
Noctuidae, species of	1996
Oecophoridae, species of	1995
Pheidole sp.	2000
Phoma sp.	1991, 1994, 1995 (3 times), 1997 (twice), 2000, 2001, 2002
(twice),	2003
Phomopsis sp.	1994, 1995 (3 times), 1996 (3 times), 1997 (twice), 1998, 1999 (twice), 2001, 2002, 2003
Phyllophaga sp.	1988
Sarasinula plebeia	1991
Sminthuridae, species of	1996
Stagonospora sp.	1995
Succinea horticola	2000
Succinea sp.	1999
Tarsonemidae, speices of	2001
Tarsonemus sp.	1996, 1998
Thripidae, species of	2002
Tinocallis sp.	1996

D. Pest Categorization

The pests associated with *S. foetida* in China are listed in Table 3. This list identifies: (1) the presence or absence of these pests in the United States, (2) the generally affected plant part or parts, (3) additional hosts, (4) the quarantine status of the pest with respect to the United States, (5) whether the pest is likely to follow the pathway to enter the United States, and (6) pertinent citations for either the distribution or the biology of the pest. Because of specific characteristics of a given pest's biology and distribution, many organisms are eliminated from further consideration as sources of phytosanitary risk because they do not satisfy the FAO definition of a quarantine pest (FAO, 2002).

Only those quarantine pests that are likely to follow the pathway are further analyzed. A quarantine pest is, "A pest of potential economic importance to the area endangered thereby and not yet present there, or present but not widely distributed and being officially controlled" (FAO, 2002). Pests not of potential economic importance, lacking the distribution requirements, or not under official control cannot be analyzed beyond listing in Table 3 because they do not meet internationally agreed criteria (FAO, 2001). For this same reason, organisms that are not agents injurious to plants (FAO, 2002) cannot be analyzed for phytosanitary concern.

Some of the quarantine pests listed in Table 3 may be potentially detrimental to the agricultural systems of the United States. There are a variety of reasons for not subjecting them to further analysis. Examples include, but are not limited to the following: non-fertile life stages can be transported in a shipment but are unable to establish viable populations upon entry into the United States, pests can become associated with the commodity because of packing or handling procedures (biological contaminants), or the pests may be associated with the commodity but will not remain with it during transport or processing. Insects with inherent mobility (wings, legs, etc.) and/or the instinct to avoid light or human activity will not remain with the commodity. In contrast, quarantine pests that are unable to leave the commodity may have immobile or cryptic life stages and can follow the pathway.

Table 3. Pests Associated with *Serissa foetida* in China.

Pest	Geographic Distribution[1]	Additional Host Genera[2]	Plant Part Affected[3]	Quarantine Pest	Follow Pathway	References
ARTHROPODA						
ACARINA						
Acarina sp.	CN, US	Various	Leaf, Stem	No	Yes	PIN 309, 2003
Daidalotarsonemus hexagonus Yang, Ding & Zhou	CN	Feeds on moss and lichen	Stem	No	Yes	Smiley, 1972; Yang *et al*., 1987; Welbourn, 2003
Daidalotarsonemus serissae Yang, Ding & Zhou	CN	Feeds on moss and lichen	Stem	No	Yes	Smiley, 1972; Yang *et al*., 1987; Welbourn, 2003
Tarsonemidae						
Tarsonemidae sp.	CN, US	Various	Unknown	Yes	Yes	PIN 309, 2003
Tarsonemus sp.	CN, US	Various	Unknown	Yes	Yes	PIN 309, 2003
COLEOPTERA						
Cerambycidae						
Cerambycidae sp.	CN, US	Various	Stem	Yes	Yes	China, 1995
Curculionidae						
Sympiezomias velatus Chevrolet	CN	Polyphagous	Whole plant	Yes	Yes	China, 1995
Scarabaeidae						
Adoretus sinicus Burmeister[4]	CN, US (HI)	Polyphagous	Leaf, Root	Yes	No	7 CFR §318.13(a); China, 1995; INKTO #89
Amphimallon solstitialis (L.)[4]	CN	Polyphagous	Leaf, Root	Yes	No	Browne, 1968; China, 1995; CIE, 1979; INKTO #99

Table 3. Pests Associated with *Serissa foetida* in China.						
Pest	Geographic Distribution[1]	Additional Host Genera[2]	Plant Part Affected[3]	Quarantine Pest	Follow Pathway	References
Anomala corpulenta Motschulsky[4]	CN	Polyphagous	Leaf, Root	Yes	No	China, 1994; 1995
Anomala cupripes Hope[4]	CN	Polyphagous	Leaf, Root	Yes	No	China, 1994; 1995; Gordon, 1994
Cyclocephala sp.	CN, US	Various	Leaf, Root	Yes	Yes	PIN 309, 2003
Phyllophaga sp.	CN, US	Polyphagous	Leaf, Root	Yes	Yes	China, 1995; PIN 309, 2003
Phyllophaga titanis Reitter[4]	CN	Polyphagous	Leaf, Root	Yes	No	China, 1994; 1995; Gordon, 1994
COLLEMBOLA						
Sminthuridae						
Sminthuridae sp.	CN, US	Various	Leaf, Soil	Yes	Yes	PIN 309, 2003
DIPTERA						
Lonchaeidae						
Lonchaeidae sp.	CN, US	Various	Unknown	Yes	Yes	PIN 309, 2003
HOMOPTERA						
Aphididae						
Aphis gossypii Glover	CN, US	Polyphagous	Leaf, Stem	No	Yes	China, 1995; CIE, 1968; Patch, 1938; Smith and Parron, 1978; Wilson and Vickery, 1981;
Myzus persicae (Sulzer)	CN, US	Polyphagous	Leaf	No	Yes	Blackman and Eastop, 2000; China, 1994; Zhang and Zhong, 1983
Tinocallis sp.	CN, US	Various	Leaf	Yes	Yes	PIN 309, 2003
Coccidae						
Sassetia olea oleae (Olivier)	CN, US	Polyphagous	Leaf, Stem	Yes	Yes	ScaleNet, 2003
Diaspididae						
Aonidiella taxus Lenonardi	CN, US	*Cephalotaxus, Podocarpus, Taxus*	Leaf, Stem	No	Yes	EPPO, 1996b; Lattin, 1998; Nakahara, 1982
Diaspididae sp.	CN, US	Various	Leaf, Stem	Yes	Yes	PIN 309, 2003
Lepidosaphes laterochitinosa Green[4]	CN	Polyphagous	Leaf, Stem	Yes	No	China, 1995; PIN 309, 2003; ScaleNet, 2003
Margarodidae						
Drosicha corpulenta (Kuwana)[4]	CN	Polyphagous	Root, Stem	Yes	No	China, 1994, 1995; Shiraki, 1952
Icerya purchasi Maskell	CN, US	Polyphagous	Leaf, Stem	No	Yes	China, 1994; CIE, 1971; Myer, 1978; Salama *et al*., 1985
Pseudococcidae						
Rhizoecus hibisci Kawai & Takag[1]	CN, US (FL, HI)[1]	Polyphagous	Root	Yes	Yes	EPPO, 1996a; ScaleNet, 2003
Rhizoecus sp.	CN, US	Various	Root	Yes	Yes	EPPO, 1996a

Table 3. Pests Associated with *Serissa foetida* in China.						
Pest	Geographic Distribution[1]	Additional Host Genera[2]	Plant Part Affected[3]	Quarantine Pest	Follow Pathway	References
HYMENOPTERA						
Formicidae						
Pheidole sp.	CN, US	Various	Unknown	Yes	Yes	PIN 309, 2003
LEPIDOPTERA						
Limacodidae						
Cnidocampa flavescens (Walker)	CN, US (MA, PA, PR)	Polyphagous	Leaf	No1	Yes	Baker, 1972; China, 1994b; EPPO, 1996b; Shiraki, 1952; Zhang, 1994
Noctuidae						
Agrotis segetum (Denis & Schiffermuller)[4]	CN	Polyphagous	Leaf, Root, Stem	Yes	No	Carter, 1984; China, 1995; INKTO #25
Chrysodeixis chalcites (Esper)[4]	CN	Polyphagous	Fruit, Inflor., Leaf, Stem	Yes	No	China, 1995; CIE, 1977; Goodey, 1991; Taylor, 1980
Mamestra brassicae (L.)[4]	CN	Polyphagous	Fruit, Inflor., Leaf, Stem	Yes	No	China, 1995; INKTO #61
Noctuidae sp.	CN, US	Various		Yes	Yes	PIN 309, 2003
Spodoptera litura (F.)[4]	CN	Polyphagous	Leaf, Root, Stem	Yes	No	China, 1995; CIE, 1993; PNKTO #24
Oecophoridae						
Oecophoridae sp.	CN, US	Various	Unknown	Yes	Yes	PIN 309, 2003
Pieridae						
Aporia crataegi L.[4]	CN	Polyphagous	Leaf	Yes	No	Anon., 1972; China, 1995; INKTO #149
Pyralidae						
Conogethes punctiferalis (Guenée)[4]	CN	Polyphagous	Fruit, Leaf, Stem	Yes	No	China, 1995; INKTO #19
ORTHOPTERA						
Acrididae						
Atractomorpha sinensis Bol.	CN, US (HI)	Polyphagous	Leaf, Soil	Yes	Yes	China, 1994, 1995
Gryllotalpidae						
Gryllotalpa orientalis Burmeister (= *G. africana* Palisot de Beauvois)[4]	CN, US (HI)	Polyphagous	Root	Yes	No	China, 1995; Hua, 2000; INKTO #197
Trydactilidae						
Tridactylus japonicus de Hoan[4]	CN	Polyphagous	Root	Yes	No	China, 1994, 1995; Shiraki, 1952
THYSANOPTERA						
Thripidae						
Frankliniella sp.	CN, US	Various	Leaf	Yes	Yes	PIN 309, 2003
Thripidae sp.	CN, US	Various	Leaf	Yes	Yes	PIN 309, 2003

Table 3. Pests Associated with *Serissa foetida* in China.

Pest	Geographic Distribution[1]	Additional Host Genera[2]	Plant Part Affected[3]	Quarantine Pest	Follow Pathway	References
Thrips palmi Karny	CN, US (American Samoa, FL, Guam, HI, PR)	Polyphagous	Inflor., Leaf, Stem	Yes	Yes	CIE, 1992; Martin and Mau, 1992; Nakahara, 1994; Payne, 2003; Smith *et al*., 1992
FUNGI						
Ascochyta sp. (Fungi Imperfecti, Coelomycete)	CN, US	Various	Leaf	Yes	Yes	PIN 309, 2003
Colletotrichum sp. (Fungi Imperfecti, Coelomycete)	CN, US	Various	Leaf	Yes	Yes	PIN 309, 2003
Coniothyrium sp. (Fungi Imperfecti, Coelomycete)	CN, US	Various	Stem	Yes	Yes	PIN 309, 2003
Cytospora sp. (Fungi Imperfecti, Coelomycete)	CN, US	Various	Stem	Yes	Yes	PIN 309, 2003
Diaporthe sp. (Ascomycetes, Diaporthales)	CN, US	Various	Stem	Yes	Yes	PIN 309, 2003
Didymella sp. (Ascomyetes, Dothideales	CN, US	Various	Stem	Yes	Yes	PIN 309, 2003
Didymosphaeria sp. (Ascomycetes, Dothideales)	CN, US	Various	Stem	Yes	Yes	PIN 309, 2003
Diplodia sp. (Fungi Imperfecti, Coelomycete)	CN, US	Various	Leaf, Stem	Yes	Yes	PIN 309, 2003
Fusicoccum sp. (Fungi Imperfecti, Coelomycete)	CN, US	Various	Leaf, Root	Yes	Yes	China, 1995; PIN 309, 2003
Leptosphaeria sp. (Ascomycetes, Dothideales)	CN, US	Various	Stem	Yes	Yes	PIN 309, 2003
Melampsora serissicola Shang, Li & Wang (Basidiomycetes, Uredinales)	CN	No additional hosts	Leaf	Yes	Yes	Farr *et al*., 1989; Shang *et al*., 1990
Microsphaeropsis sp. (Fungi Imperfecti, Coelomycete)	CN, US	Various	Leaf	Yes	Yes	PIN 309, 2003
Pestalotiopsis sp. (Fungi Imperfecti, Coelomycete)	CN, US	Various	Leaf	Yes	Yes	China, 1994
Phoma sp. (Fungi Imperfecti, Coelomycetes)	CN, US	Various	Whole plant, Soil	Yes	Yes	China, 1994; PIN 309, 2003
Phomopsis sp. (Fungi Imperfecti, Coelomycetes)	CN, US	Various	Leaf, Stem	Yes	Yes	SBML, 2003; PIN 309, 2003
Stagonospora sp. (Fungi Imperfecti, Coelomycete)	CN, US	Various	Leaf	Yes	Yes	SBML, 2003; PIN 309, 2003
NEMATODA						
Aphelenchida						
Aphelenchoididae						

Table 3. Pests Associated with *Serissa foetida* in China.						
Pest	Geographic Distribution[1]	Additional Host Genera[2]	Plant Part Affected[3]	Quarantine Pest	Follow Pathway	References
Aphelenchoides besseyi Christie	CN, US	Polyphagous	Leaf, Root, Soil	No	Yes	Anon., 1984; EPPO, 1996a
Aphelenchidae						
Aphelenchus sp.	CN	Various	Root, Soil	Yes	Yes	EPPO, 1996a
Dorylaimida						
Dorylaimidae						
Dorylaimidae sp.	CN	Various	Root, Soil	Yes	Yes	EPPO, 1996a
Dorylaimus sp.	CN	Various	Root, Soil	Yes	Yes	EPPO, 1996b
Xiphinematidae						
Xiphinema brasiliense Lordello[1]	CN[1]	Polyphagous	Root, Soil	Yes[1]	Yes	Anon., 1984; EPPO, 1996b
Xiphinema sp.	CN	Various	Root, Soil	Yes	Yes	EPPO, 1996a, b
Tylenchida						
Criconematoidea						
Belonolaimidae						
Paratrophurus sp.	CN	Various	Root, Soil	Yes	Yes	EPPO, 1996a
Tylenchorhynchus sp.	CN	Various	Root, Soil	Yes	Yes	EPPO, 1996a
Tylenchorhynchus crassicaudatus Williams	CN	*Musa, Oryza, Saccharum, Sorghum*	Root, Soil	Yes	Yes	EPPO, 1996a, b; Lin and Chiu, 1971; Rodriguez and Ayala, 1977; Williams, 1960
Tylenchorhynchus leviterminalis Siddiqi, Mukherjee & Dasgupta	CN	Polyphagous	Root, Soil	Yes	Yes	EPPO, 1996a, b
Criconematidae						
Criconemella sp.	CN	Various	Root, Soil	Yes	Yes	EPPO, 1996a
Hoplolaimidae						
Helicotylenchus dihystera (Cobb) Sher.	CN, US	Polyphagous	Root, Soil	No	Yes	Anon., 1984; EPPO, 1996, b
Helicotylenchus sp.	CN	Various	Root, Soil	Yes	Yes	EPPO, 1996a, b
Rotylenchus robustus (deMan) Filipjev	CN, US	Polyphagous	Root, Soil	No	Yes	EPPO, 1996b
Heteroderidae						
Meloidogyne sp.	CN	Various	Root, Soil	Yes	Yes	EPPO, 1996b
Meloidogyne incognita (Chitwood)	CN, US	Various	Root, Soil	No	Yes	Anonymous, 1984
Pratylenchidae						
Hirschmanniella sp.	CN	Various	Root, Soil	Yes	Yes	EPPO, 1996a, b
Pratylenchus sp.	CN	Polyphagous	Root, Soil	Yes	Yes	EPPO, 1996a, b
Pratylenchus brachyurus (Godfrey) Filipjev & Schuurmans Stekhoven	CN, US	Polyphagous	Root, Soil	No	Yes	Anon., 1984; EPPO, 1996b
Tylenchidae						
Tylenchus sp.	CN	Various	Root, Soil	Yes	Yes	EPPO, 1996a
Triplonchida						
Trichodoridae						
Trichodorus sp.	CN	Various	Root, Soil	Yes	Yes	EPPO, 1996a

Pest	Geographic Distribution[1]	Additional Host Genera[2]	Plant Part Affected[3]	Quarantine Pest	Follow Pathway	References
MOLLUSCA						
Bradybaenidae						
Bradybaena similaris (Ferussac)	CN, US	Polyphagous	Whole plant, Soil	No	Yes	Chang and Chen, 1989; China, 1994; Dundee, 1970; Yen, 1943
Succineidae						
Succinea horticola Reinhart	CN	Polyphagous	Whole plant, Soil	Yes	Yes	PIN 309, 2003
Succinea sp.	CN	Various	Whole plant, Soil	Yes	Yes	PIN 309, 2003
Philomycidae						
Meghimatium sp. (= *Incilaria* sp.)	CN, US	Unknown	Unknown	Yes	Yes	China, 1994, 1995
Veronicellidae						
Sarasinula plebeia (Fischer)	CN	Polyphagous	Whole plant, Soil	Yes	Yes	PIN 309, 2003

Table 3. Pests Associated with *Serissa foetida* in China.

[1]Geographic Distribution: CN - China, US - United States, FL - Florida, HI - Hawaii, MA - Massechusettes. Individual states are listed only if the pest is reported in less than five States or US territories. The organisms with limited US distribution that are likely to follow the pathway are *Thrips palmi, Rhizoecus hibisci* and *Cnidocampa flavescens*. See textual discussion following Table 3. Analysis in this document shall not be construed as any type of indicator on future agency policy for these pests.

[2]Polyphagous means the species feeds and reproduces on multiple hosts in multiple plant families. Various means different species use a variety of hosts. When species of *Serissa* are the only hosts reported in the available literature, then "No additional hosts" is noted in the Table.

[3]Plant Part Affected: Inflor. - inflorescence.

[4]The following pests are generalist feeders that were not listed as present on *Serissa* in Chinese penjing gardens (China, 1995): *Adoretus sinicus, Agrotis segetum, Amphimallon solstitialis, Anomala corpulenta, A. cupripes, Aporia crataegi, Chrysodeixis chalcites, Conogethes punctiferalis, Drosicha corpulenta, Gryllotalpa orientalis, Lepidosaphes laterochitinosa, Mamestra brassicae, Phyllophaga titanis, Spodoptera litura*, and *Tridactylus japonicus* (China, 1995). Published biological evidence validates the information supplied by the Chinese government that *Serissa* is not a host of these pests. In 1996, some of these pests were assessed as following the pathway due to their generalist habits, but current information shows that these pests are not likely to follow the pathway of this importation.

The unknown taxonomic status associated with species of A*Calyptozele*@ was prompted by a submission of this genus name by the ASIQ (China, 1995), which could not be substantiated as having an equivalent in the scientific literature. Literature searches did not find any synonymy to other existing genera. Therefore, this ambiguous name was excluded from consideration in this analysis. It is assumed that the risk associated with this organism is no greater than the highest ratings for any other pest within each category. *Cnidocampa flavescens* does not meet the definition of a quarantine pest (FAO, 2002).

The nematode *Xiphinema brasiliense* was identified in Putnam County, Florida in 1959 (Lehman, 2002) and in California in 1974 (Hackney, 2003). The Society of Nematology personal communication reference to its presence in Florida may have been the same 1959 isolation (Anon., 1984; Handoo, 2003). There appear to be no other reports of *X. brasilense* in the United States. For the purpose of this document, it is considered a quarantine pest because it was not identified in the United States in at least the last 25 years.

The interceptions on bonsai from China (EPPO, 1996a, b) do not explicitly link the host to the intercepted pest. Based on these reports, all the intercepted pests are ascribed to *Serissa* in this document. The newly described Acarina (*Daidalotarsonemus hexagonus* and *D. serissae*) are not listed as quarantine pests but they are likely to follow the pathway because of the finding of a plant with *Daidalotarsonemus* in Florida (Anon., 2000). Members of this genus presumably feed on lichens and fungi, so despite being associated with tree bark (Smiley, 1972; Yang *et al*., 1987), these species do not appear to be pests (Ochoa, 2003) and are not further analyzed.

The biological hazard of organisms not identified to the species level was not directly assessed. In this risk assessment, this applies to the interceptions of *Acarina* sp., *Ascochyta* sp., *Colletotrichum* sp., *Coniothyrium* sp., *Cyclocephala* sp., *Cytospora* sp., *Diaporthe* sp., Diaspididae, *Didymella* sp., *Didymosphaeria* sp., *Diplodia* sp., *Frankliniella* sp., *Fusicoccum* sp., *Leptosphaeria* sp., Lonchaeidae, *Microsphaeropsis* sp., Noctuidae, Oecophoridae, *Pheidole* sp., *Phoma* sp., *Phomopsis* sp., *Phyllophaga* sp., *Sarasinula plebeia*, Sminthuridae, *Stagonospora* sp., *Succinea* sp., Tarsonemidae, *Tarsonemus* sp., Thripidae, and *Tinocallis* sp. Stakeholder comments suggested that even if USDA did not have information about specific quarantine species, it should assume that they exist. That approach (specifically, assuming there are hazards without evidence to identify these hazards) is not consistent with international guidelines or agreements. It is reasonable, however, to assume that the biologies of congeneric organisms are similar and can be related to organisms that are analyzed. And that in addressing these unknowns with specific, applicable mitigations that target biologically similar groups (similar in a phytosanitary-relevant sense) similar treatments and controls will apply. For example, the analysis of the nematodes *T. crassicaudatus*, *T. leviterminalis* and *X. brasiliense* reasonably encompasses the concerns posed by other, incompletely identified nematodes such as: *Aphelenchus* sp., *Paratrophorus* sp., *Criconemella* sp., *Dorylaimus* sp., *Helicotylenchus* sp., *Hirschmanniella* sp., *Meloidogyne* sp., *Pratylenchus* sp., *Trichodorus* sp., *Tylenchorhynchus* sp., *Tylenchus* sp., and *Xiphinema* sp. The biological information available for *Rhizoecus hibisci* is used to analyze *Rhizoecus* sp. *Phomopsis* sp. will be analyzed because of the large number of interceptions of this fungus on bare-root plants (Table 2), and to represent other stem-canker causing fungi (primarily in the Coelomycetes). *Phomopsis* is used to encompass the analysis of several unidentified fungal species because these fungi generally are susceptible to similar control measures.

Many of the pests in Table 3 identified only to the order, family or generic level are based on PPQ interceptions (Acarina, *Ascochyta* sp., *Colletotrichum* sp., *Coniothyrium* sp., *Cyclocephala* sp., *Cytospora* sp., *Diaporthe* sp., Diaspididae, *Didymella* sp., *Didymosphaeria* sp., *Diplodia* sp., *Frankliniella* sp., *Fusicoccum* sp., *Leptosphaeria* sp., Lonchaeidae, *Microsphaeropsis* sp., Noctuidae, Oecophoridae, *Pheidole* sp., *Phoma* sp., *Phomopsis* sp., Sminthuridae, *Stagonospora* sp., *Succinea* sp., Tarasonemidae, *Tarsonemus*, Thripidae, *Tinocallis* sp.). Often the pest could not be completely identified because the intercepted life stage lacks structures that allow identification to species. In this risk assessment, this applies to the interceptions of Acarina, Lonchaeidae, Sminthuridae and Thripidae as well as a number of genera. Lack of species identification may indicate the limits of the current taxonomic knowledge or the life stage or the quality of the specimen submitted for identification. Even if they could be identified, these pests may or may not belong to quarantine pest species. The intercepted pests identified only to higher taxa may actually belong to a non-quarantine species already addressed in the document under a species epithet, *e.g.*, the Diaspdidae includes non-quarantine pests like *Aonidiella taxus*.

Other plant pests listed in Table 3 may be potentially detrimental to the agricultural systems of the United States, however, there were a variety of reasons for not subjecting them to further analysis. For example, the pests may not be associated with the commodity during transport or processing because of their inherent mobility and/or instinct to avoid light (negative phototaxis), such as *Atractomorpha sinensis*, or human activity; non-fertile insect stages can be transported in a shipment but are unable to establish viable populations upon entry, *e.g. Pheidole* sp.; or pests intercepted during examination by PPQ Officers at Plant Introduction Stations, as biological contaminants of the commodity and are not expected to be present in every shipment.

The quarantine pests that are likely to follow the pathway of importation on species of *Serissa foetida* from China are summarized in Table 4.

Table 4. Quarantine Pests Likely to Follow Pathway on *Serissa foetida* from China

ARTHROPODA **Coleoptera** *Sympiezomias velatus* Chevrolet (Curculionidae) **Homoptera** *Rhizoecus hibisci* Kawai & Takagi (Pseudococcidae) **Thysanoptera** *Thrips palmi* Karny (Thripidae) **MOLLUSCA** *Sarasinula plebeia* (Fischer) (Veronicellidae) *Succinea horticola* Reinhart (Succineidae)	**FUNGI** *Melampsora serissicola* Shang, Li & Wang (Basidiomycetes, Uredinales) *Phomopsis* sp. (Fungi Imperfecti, Coelomycetes) **NEMATODA** *Xiphinema brasiliense* Lordello (Xiphinematidae) *Tylenchorhynchus crassicaudatus* Williams (Belonolaimidae) *Tylenchorhynchus leviterminalis* Siddiqi, Mukherjee & Dasgupta (Belonolaimidae)

E. Analysis of Quarantine Pests

The undesirable consequences that may occur from the introduction of quarantine pests are assessed within this section. For each quarantine pest, the Pest Risk Potential is calculated by summing the values for the Consequences of Introduction and the Likelihood of Introduction.

The major sources of uncertainty present in this risk assessment are similar to those in other risk assessments. They include the approach used to combine risk elements (Bier, 1999; Morgan and Henrion, 1990), and the evaluation of risk by comparisons to lists of factors within the guidelines (Kaplan, 1992). To address this last source of uncertainty, the lists of factors were interpreted as illustrative and not exhaustive. This implies that additional biological information, even if not explicitly part of the criteria, can be used when it informs a rating. Sources of uncertainty in this analysis stem from the quality of the available biological information (Gallegos and Bonano, 1993), and the inherent, natural biological variation within a population of organisms (Morgan and Henrion, 1990).

Consequences of Introduction

This portion of the analysis considers negative outcomes that may occur when the quarantine pests identified as following the pathway of *S. foetida* penjing plants from China are introduced into the United States. The potential consequences are evaluated using the following five Risk Elements: Climate-Host Interaction, Host Range, Dispersal Potential, Economic Impact, and Environmental Impact. These risk elements reflect the biology, host range and climatic and geographic distribution of each pest, and are supported by biological information on each of the analyzed pests. For each risk element, pests are assigned a rating of Low (1 point), Medium (2 points), or High (3 points) based on the criteria as stated in the Guidelines (APHIS, 2000). The summation of the points for each risk rating is the cumulative value for the Consequences of Introduction (Table 5). A cumulative value of 5 to 8 points is considered Low risk for the Consequences of Introduction, 9 to 12 points is Medium, and 13 to 15 points is considered High (APHIS, 2000).

<u>Risk Element 1: Climate/Host Interaction</u>

This risk element considers ecological zonation and the interactions of quarantine pests with their biotic and abiotic environments. When introduced into new areas, pests are expected to behave as they do in their native areas if the potential host plants and suitable climate are present. Broad availability of suitable climates and a wide distribution of suitable hosts are assumed to increase the impact of a pest introduction. The ratings for this risk element are based on the relative number of United States Plant Hardiness Zones (USDA, 1960) with potential host plants and suitable climate.

The variety of climatological regions in China corresponds to many of the climatological regions in the United States because they are at similar latitudes and range from coastal to mountainous regions (Hou, 1983). Penjing plants of *S. foetida* are generally grown indoors and/or in temperature controlled production facilities in the United States (Anon., 2003a; Anon., 2003b). Based on the reported range for *Serissa* (NRCS, 2003), three US Hardiness Zones will support outdoor *S. foetida* populations (USDA, 1960). The risk rating of Medium (2) given for each of these species for the Climate-Host Interaction Risk Element reflects the uncertainty associated with the potential for outdoor growth of these plants.

Generally, *Thrips palmi* is subtropical to tropical in distribution, but populations in temperate climates overwinter in greenhouses and interiorscapes (CPC, 2002). It cannot survive subzero temperatures for more than a few days (Lewis, 1997). This species occurs in Asia, parts of the tropical Pacific, Africa, Australia, Japan, and South America and European greenhouses (CPC, 2002; Lewis, 1997). The U.S. populations are limited to Hawaii, southern Florida, Guam, Puerto Rico and American Samoa. These areas correspond to Plant Hardiness Zones 9-11 and under field conditions its distribution is likely to be limited to tropical areas (Capinera, 2000) or areas with mild winters (Tsai *et al.*, 1995). For these reasons, the Climate/Host Interaction for this pest is Medium (2).

<u>Risk Element 2: Host Range</u>

The risk posed by a plant pest depends on both its ability to establish a viable, reproductive population and its potential for causing plant damage. This risk element assumes that the consequences of pest introduction are positively correlated with the pest's host range. Aggressiveness, virulence and pathogenicity also may be factors. The consequences are rated as a function of host range and consider whether the pest can attack a single species or multiple species within a single genus, a single plant family, or multiple families. The large number of hosts, in multiple plant families, attacked by these pests warrants a risk rating for Host Range of High (3) for all of the pests unless otherwise noted.

The weevil *Sympiezomias velatus*, feeds on at least the following plants: *Beta, Buxus, Castanea, Glycine, Morus, Populus,* and *Sophora* (China, 1995).

Rhizoecus hibisci feeds on: *Buxus, Calibanus, Carex, Chusquea, Crinum, Cryptanthus, Cuphea, Dichorisandra, Dieffenbachia, Dioscorea, Hakonechloa, Hibiscus, Nerium, Pelargonium, Phoenix, Rhaphis, Sabal, Sageretia, Serissa, Zelkova* and *Zingiber* (CPC, 2002).

Thrips palmi is reported on many members of the Cucurbitaceae, Fabaceae, and Solanaceae (CPC, 2002; Capinera, 2000; Nakahara, 1994). The host range also includes the following ornamental plants in other plant families: *Chrysanthemum*, *Cyclamen*, *Dahlia*, *Dianthus* and "various orchids" (Nakahara, 1994).

Snails (*Succinea horticola*) and slugs (*Sarasinula plebeia*) feed on foliage, flowers and fruit from various plant species, especially in greenhouses (Godan, 1983; Robinson, 2003), so identifying specific "hosts" is likely to underestimate the full range of plants that they can feed on. As an example of this diversity, a listing of plants intercepted with *S. horticola* from China includes: *Buxus, Carmona*, *Chamaedorea*, *Dracaena*, *Pinus, Serissa* and *Zelkova* (PIN 309, 2003). Another example of this diversity is a listing of plants intercepted with *Sarasinula plebeia* which includes: *Ananas, Chamaedorea*, *Dracaena*, *Eryngium*, *Musa* and Orchidaceae (PIN 309, 2003).

The only reported host for *Melampsora serissicola* rust is *Serissa serissoides* (Shang *et al*., 1990), so the host range rating is Low (1).

The host range rating for *Phomopsis* is High (3) because without knowing the specific species, it is assumed that there is a risk that a novel species will be able to infect multiple species among multiple plant families should it enter and establish within the United States.

The host range for *T. crassicaudatus* includes *Musa* (Zhang *et al*., 1995), *Oryza* (Lin and Chiu, 1971), *Saccharum* (Williams, 1960), and *Sorghum* (Rodriguez and Ayala, 1977). The hosts for *T. leviterminalis* include: *Canarium* (Zhang *et* al., 2002), *Dimocarpus* (Liu and Zhang, 1999), *Rosa* (Pathak and Siddiqui, 1997), *Lycopersicon* (Campos and Sturhan, 1987), *Musa* (Campos *et al*., 1987; Zhang *et al*., 1995), *Oryza* (Campos *et al*., 1987), and *Saccharum* (Talavera *et al*., 2002).

The host range for *X. brasiliense*, includes *Carica*, *Cocos*, *Piper*, *Podocarpus* (Arias *et al*., 1995), *Citrus* (Crozzoli *et al*., 1998), *Croton* (Zem, 1977), *Nicotiana, Mangifera*, *Theobroma* (CPC, 2002), *Prunus* and *Vitis* (Maximiniano *et al*., 1998), and *Solanum* (Charchar, 1997).

<u>Risk Element 3: Dispersal Potential</u>

Pests may disperse after introduction into new areas. The dispersal potential indicates how rapidly and widely the pest's impact may be expressed within the importing country or region and is related to the pest's reproductive potential, inherent mobility, and external dispersal facilitation modes. Factors for rating the dispersal potential include: the presence of multiple generations per year or growing season, the relative number of offspring or propagules per generation, any inherent capabilities for rapid movement, the presence of natural barriers or enemies, and dissemination enhanced by wind, water, vectors, or human assistance.

In the United States, plants within the genus *Serissa* generally are grown indoors (Anon., 2003a; Anon., 2003b). The possibility of mobile pests migrating to outdoor native host plants, particularly during transport, cannot be precluded.

Rhizoecus hibisci is associated with soil and the roots of plants (McKenzie, 1967; Hata *et al*., 1996; Kosztarab, 1996). Adults and nymphs may crawl out of pot drainage holes or be dispersed in drained water into other pots in a greenhouse (Hata *et al*., 1996; McKenzie, 1967) so local dispersal within a greenhouse can occur, and long-distance transport occurs as plants are traded in commerce (EPPO, 1996a; Hata *et al*., 1996). The dispersal potential risk rating is Medium (2). The dispersal capabilities of *Sympiezomias velatus* are not known. However, many curculionids , *e.g*., *Anthonomus grandis* Boheman http://www.ceris.purdue.edu/napis/pests), are capable of widespread distribution so it is rated High (3).

The fecundity of *Thrips palmi* ranges from 3 to 205 eggs per female (CPC, 2002). Dispersal of adults is susceptible to wind and weather because of their small size (Martin and Mau, 1992). Thrips, in general, are believed to alternate between active wing beating in warmer temperatures and passive descent in cooler temperatures during long-distance flight (Lewis, 1997). *Thrips palmi* moves in commodities in international trade as evidenced by the high number of interceptions, particularly in cut flowers (PIN 309, 2003). This pest exhibits high reproductive potential and dispersal capability so it is rated High (3).

Snails and slugs are spread in commerce, may lay up to 100 eggs at one time (Anon., 2003c) and due to their hermaphroditism, one organism can start a population (Godan, 1983; Anon., 2003c). *Succinea horticola* Reinhart is the most important species in its family, and is a very severe pest of greenhouse plants and grasses (AFPMB, 1993). It is found mainly in China, Japan and Okinawa, and also occurs in Greece and Italy (AFPMB, 1993). Although this species is not listed as a "traveling species", succineids are difficult to identify to the species level (Robinson, 1999). Currently, snail infestations are of heightened concern to APHIS-PPQ because of increase in volume of transported materials and the establishment of the Channeled apple snail, *Pomacea caniculata* (Lamarck) in California and Texas (Robinson, 1999; Smith and Fowler, 2002).

The slug, *Sarasinula plebeia* also is distributed in trade and local movement is slow (Anon., 2003c). The dispersal potential risk rating is High (3).
It is expected that spores of *M. serissicola*, like other rust fungi, will be widely dispersed by wind (Agrios, 1997; Arthur, 1962) so the risk rating for this fungus is High (3). Members of the genus *Phomopsis* discharge spores from fruiting structures, which are then dispersed primarily by rain and wind (Agrios, 1997; Pirone, 1978). So properly watered infected indoor plants are unlikely to widely disperse spores to outdoor plants, and the risk rating is Medium (2).

The nematodes of concern, *T. crassicaudatus*, *T. leviterminalis* and *X. brasiliense*, are all migratory parasites so natural short-distance or local dispersal will occur when infested potted plants are placed in contact with soil (Agrios, 1997; Jones and Benson, 2001; Sikora, 1992). Long distance dispersal will occur through commerce so the risk rating is Low (1).

Risk Element 4: Economic Impact
Introduced pests cause a variety of direct and indirect economic impacts, such as reduced yield, reduced commodity value, loss of foreign or domestic markets, and non-crop impacts. Factors considered during the ranking process included the effect on yield or commodity quality, cause plant mortality, act as a disease vector, increase costs of production including pest control costs, lower market prices, effect market availability, increase research or extension costs, or reduce recreational land use or aesthetic value.

The weevil *Sympiezomias velatus* feeds on economically and environmentally important species of *Glycine* and *Populus* (China, 1995), so it is rated High (3). In the greenhouse, *Rhizoecus hibisci* is a pest of ornamentals that can cause serious damage to roots (Kawai and Takagi, 1971) but it does not appear to be damaging outside of greenhouses in Hawaii (Hata *et al*., 1996) so the rating is Medium (2).

Thrips palmi severely damages vegetable crops, and is a vector of tomato spotted wilt tospovirus (CPC, 2002; Tsai *et al*., 1995). Extensive feeding by larvae and adults on leaves, stems, flowers and fruit produce scarring and deformities (Martin and Mau, 1992). Terminal growth of these crops becomes stunted, discolored and deformed (Capinera, 2000), and leaves of heavily infested plants appear silvered or bronzed (Martin and Mau, 1992). The extent of damage caused to penjing plants appears to be low because *T. palmi* is a primary pest of Cucurbitaceae, Fabaceae, and Solanaceae (CPC, 2002; Capinera, 2000; Nakahara, 1994). Control programs relying on ultra-violet reflective sheets in greenhouses may be effective in reducing populations (Lewis, 1997), but to date, overall market effects of these measures have not been examined. For these reasons, the rating for economic impact is High (3).

Mollusk feeding reduces the visual quality of the plant, the available photosynthetic surface area, and some mollusks clip succulent plant parts (Godan, 1983; Ohlendorf, 1999; Lai, 1984).
The introduction of *Bradybaena similaris* (Ferrussac) into Louisiana and other states from tropical China necessitated control treatments for this occasional citrus and garden pest (Aguirre and Poss, 2000). The mollusk, *Sarasinula plebeia* is a key intermediary host for the human disease agent

Angiostrongylus costaricensis (Morera and Céspedes, 1971; Chabaud, 1972), and the increased spread of this disease is likely to be associated with entry of this intermediate host (http://www.cdfound.to.it/HTML/angio.htm). It is anticipated that if *S. plebeia* or *Succinea horticola* are introduced into new areas, there will be a need for control measures, so the rating is High (3).

Melampsora serissicola is likely to reduce aesthetic quality, but is not anticipated to kill host plants unless an epidemic on *Serissa* hosts is uncontrolled (Agrios, 1997; Arthur, 1962) so the rating is Low (1). Stem-infecting fungi, such as *Phomopsis*, may kill host plants over time, but because environmental conditions needed for infection do not continually occur (Agrios, 1997; Pirone, 1978; Van der Plank, 1963) the risk rating for this fungus is Medium (2).

Nematode infestations are cryptic and unlikely to be observed except as reduced plant vigor. Although local dispersal may lead to permanent infestations within a greenhouse or nursery (Agrios, 1997; Jones and Benson, 2001), minimal long-distance dispersal affecting all potential hosts is expected unless infected *Serissa* are used as landscape ornamentals and alternative hosts are nearby. Even if this occurs, minimal economic impact is likely for several reasons. First, many of the hosts are not grown throughout the continental United States, *e.g. Saccharum*, and citrus. Second, organic mulches and green manure may be antagonistic to nematode populations (Sikora, 1992). Third, the pantropical *X. brasiliense* (Luc and Coomans, 1992) is associated with native forest flora (Fortuner and Couturier, 1983). For these reasons, the economic impact rating for *T. crassicaudatus*, *T. leviterminalis* and *X. brasiliense* is Low (1).

Risk Element 5: Environmental Impact

The ratings for this risk element are based on three aspects: the potential for disrupting native ecosystems, based on the habits exhibited within its current geographic range, the need for additional chemical or biological control programs, the potential to directly or indirectly impact species listed as Threatened or Endangered (50 CFR § 17.11-12) by infesting or infecting a listed plant that is in the same genus as its hosts. When a pest is known to infest or infect other species within the same genus, and feeding preference data does not exist with the listed plant, then the listed plant is assumed to be a potential host. The insects exhibit wide host ranges in China, but the most likely effect is to reduce vigor although young plants can be killed (Agrios, 1997; Carter, 1984; Borror *et al.*, 1989; Hill, 1987), for this reason, *Sympiezomias velatus* is rated Medium (2).

Sustained epidemics over time are often needed for leaf-spot pathogens to directly kill host plants (Agrios, 1997; Van der Plank, 1963). While rust fungi are devastating to susceptible crops under intense agricultural production practices, the spread of rusts in non-managed situations is likely to be highly dependent on both plant density and prevailing environmental conditions (Agrios, 1997; Gilbert, 2002; Van der Plank, 1963). For the fungus *Melampsora serissicola* and the nematode, *Tylenchorhynchus crassicaudatus*, there are no hosts that are in the same genera as species listed as Threatened, Endangered or proposed (Candidate) species for listing (USFWS, 2002). The risk rating for these two pests is Low (1) because of the low prevalence of *Serissa* in US native ecosystems, the pests' narrow host ranges, and because existing mitigation measures used against other pests are likely to provide adequate control. The environmental impact rating for *Phomopsis* is High (3) because without knowing the specific species, we assume that there is a risk that a novel species will be able to infect multiple species among multiple plant families should it enter and establish within the United States.

Several of the pests have hosts that are in the same genus as species that are listed as Threatened, Endangered or Candidates for listing (USFWS, 2002). Potential hosts for *R. hibisci* could include: the Endangered species of *Buxus vahlii* found in Puerto Rico and the Virgin Islands; the Endangered *Carex albida* and *C. lutea* in California and North Carolina, respectively; the Threatened *C. specuicola* in Arizona and Utah; the Endangered *Hibiscus arnottianus* ssp. *immaculatus*, *H. brackenridgei*, *H. clayi*, and *H. waimeae* ssp. *hannerae* in Hawaii; and the Candidate *H. dasycalyx* in Texas (NatureServe, 2003). Potential hosts for *T. leviterminalis* could include the Endangered *Euphorbia haeleeleana* in Hawaii and the Threatened *E. telephioides* in Florida (NatureServe, 2003). Potential hosts for *X. brasiliense* include the Endangered *Prunus geniculata* in Florida, and the Endangered species *Solanum drymophilum* in Puerto Rico, *S. incompletum* and *S. sandwicense* in Hawaii, and the Candidate *S. nelsonii* in Hawaii (NatureServe, 2003). The environmental risk rating for *R. hibisci*, *T. leviterminalis*, and *Xiphinema brasiliense* is High (3).

Potential hosts for *Thrips palmi* could include the Endangered species *Allium munzii* located in California; *Cucurbita okeechobeensis* ssp. *okeechobeensis* and *Prunus geniculata* in Florida; *Helianthus schweinitzii* in North and South Carolina; *Vigna o-wahuensis* in Hawaii; *Solanum drymophilum* in Puerto Rico; and *S. incompletum* and *S. sandwicense* in Hawaii (NatureServe, 2003). Additional potential hosts for *T. palmi* could also include the Threatened species of *H. eggertii* in Alabama, Kentucky, and Tennessee and *H. paradoxus* in New Mexico and Texas, as well as the Candidate species *S. nelsonii* in Hawaii and *H. verticillatus* in Alabama, Georgia, and Tennessee (NatureServe, 2003). The following genera of hosts (Capinera, 2000; CPC, 2002; Nakahara, 1994) for *Thrips palmi* do not have species listed as Endangered, Threatened or Candidates for listing (USFWS, 2003): *Capsicum, Chrysanthemum, Citrus, Cucumis, Cyclamen, Dahlia, Dianthus, Glycine, Gossypium, Ipomoea, Lactuca, Lycopersicon, Mangifera, Nicotiana, Oryza, Persea, Phaseolus,* and *Sesamum*. Resistance to oxamyl and organophosphates is reported, and while methiocarb was effective in one study, it is not registered for use on vegetable crops in the United States (Martin and Mau, 1992). The environmental risk rating for *Thrips palmi* is High (3).

Conversely, the single interception of *Sarasinula plebeia* on *Eryngium* sp. is not used to infer that the endangered species *E. aristulatum* var. *parishii*, *E. constancei*, *E. cuneifolium* (NatureServe, 2003) are at-risk from this mollusk. Making this inference would incorrectly apply a “host range” concept to this pest because slugs and snails feed on various plant material as it becomes available (Robinson, 2003). Instead, the environmental risk rating is High (3) for both mollusks because all listed plant species are at-risk from these non-host specific organisms. Unless specifically mentioned above, there are no other hosts for these pests that are in the same genera as species listed as Threatened, Endangered or proposed (Candidate) species for listing.

Table 5. Risk Ratings and the Value for the Consequences of Introduction[1].						
Pest	Climate / Host	Host Range	Dispersal Potential	Economic Impact	Environmental Impact	Consequences of Introduction
Sympiezomias velatus	Medium (2)	High (3)	High (3)	High (3)	Medium (2)	High (13)
Rhizoecus hibisci	Medium (2)	High (3)	Medium (2)	Medium (2)	High (3)	Medium (12)
Thrips palmi	Medium (2)	High (3)	High (3)	High (3)	High (3)	High (14)
Sarasinula plebeia *Succinea horticola*	Medium (2)	High (3)	High (3)	High (3)	High (3)	High (14)
Melampsora serissicola *Phomopsis* sp.	Medium (2)	Low (1) High (3)	High (3) Medium (2)	Low (1) Medium (2)	Low (1) High (3)	Low (8) Medium (12)
Tylenchorhynchus crassicaudatus *T. leviterminalis* *Xiphinema brasiliense*	Medium (2)	High (3)	Low (1)	Low (1)	Low (1) High (3) High (3)	Low (8) Medium (10) Medium (10)

[1]Individual ratings are presented when there is variability within a risk element, otherwise a single rating applies to all the pest organisms within that taxa for that risk element.

Likelihood of Introduction

The Likelihood of Introduction for a pest is rated relative to six factors (APHIS, 2000). The assessment rates five of these areas based on the biological features exhibited by the pest's interaction with the commodity. These areas represent a series of independent events that must all take place before a pest outbreak occurs. These five areas are: the availability of post-harvest treatments, whether the pest can survive through the interval of normal shipping procedures, whether the pest can be detected during a port of entry inspection, the likelihood that the pest will be imported or subsequently moved into a suitable environment, and the likelihood that the pest will come into contact with suitable hosts. The value for the Likelihood of Introduction is the sum of the ratings for the Quantity Imported Annually and these biologically based areas (Table 6). The following scale is used to interpret this total: Low is 6-9 points, Medium is 10-14 points and High is 15-18 points.

Risk Element 6, subelement 1: Quantity Imported Annually

The rating for this risk element is based on the amount reported by the country of proposed export converted into standard units of 40-foot long shipping containers (APHIS, 2000; Cargo Systems, 2001). The quantity of *S. foetida* to be shipped annually from China is projected to fill ten to one-hundred 40-foot shipping containers. For this reason, this element is rated as Medium (2).

Risk Element 6, subelement 2: Survive Postharvest Treatment

Whole trees are not likely to receive postharvest treatments such as irradiation, methyl bromide, or steam sterilization because there is no "harvest"of the commodity, and the types of treatments that would kill pests are also likely to kill the trees. Like other post-harvest treatments, the presence of artificial media and/or pots requires specific testing to ensure the efficacy of any proposed post-harvest treatments (Paull and Armstrong, 1994). For this reason, all of the pests are rated High (3).

Risk Element 6, subelement 3: Survive Shipment

This sub-element evaluates the mortality of the pest population during shipment of the commodity. Shipments of *S. foetida* are not likely to be refrigerated and may spend two to four weeks in maritime transit to the United States (Cargo Systems, 2001; AQIM, 2002). Direct air shipments will not take this long. Interceptions by PPQ of the various pests (on any host) is evidence that these pests can survive the ambient transport conditions (PIN 309, 2003). For this reason, all of the pests are rated High (3).

Risk Element 6, subelement 4: Not Detected at Port of Entry

In general, careful inspection for the mobile life stages of insect pests can detect them despite their small size (Rosen, 1990). The very high number of interceptions of these pests from any country and on any commodity confirms that trained inspectors can find insect pests in shipments (PIN 309, 2003). *Sympiezomias velatus* are large and highly visible, but the soil-borne larvae are likely to evade detection without destructive sampling. For this reason, all this pest is rated Medium (2).

Some pests, however, are more difficult to detect. The mealybug, *R. hibisci*, feeds on the roots of its host (Williams, 1996). If present, the microscopic nematodes (*Tylenchorhynchus crassicaudatus*, *T. leviterminalis* and *X. brasiliense*) will swim in the water associated with the roots of the plants (Agrois, 1997) and remain undetected. The snail *Succinea horticola* and the slug *Sarasinula plebeia,* are likely to be detected only if slime trails are present, but eggs and populations resident in the growing medium are likely to evade detection without destructive sampling (Anon., 2003c; Burch, 1962; Godan, 1983; Lai, 1984). Due to the difficulty of detection, all of these pests are rated High (3).

Large infestations of *Thrips palmi* are likely to be detected by the leaf symptoms (Martin and Mau, 1992), but small life stages, limited populations, or soil-borne life stages are likely to evade detection (CPC, 2002) so the rating is Medium (2). Both of the fungi are in genera where latent periods occur (Agrios, 1997). While leaf spot symptoms are easily detected (Pirone, 1978), latent infections or dormant spores present on the plants will be undetected, so the rating for the fungi (*M. serissicola* and *Phomopsis* sp.) is Medium (2).

Risk Element 6, subelement 5: Imported or Moved To An Area Suitable for Survival

This sub-element considers the geographic location of likely markets and the chance of the commodity moving to locations suitable for the pest's survival. Plants for planting that arrive in the United States are distributed according to market demand. All of the pests, except for *Thrips palmi*, are rated Medium (2) because non-cultivated, landscape and ornamental hosts are widespread throughout the United States (Bailey *et al*., 1976; NRCS, 2003), and outdoor locations for the artificially dwarfed plants may provide suitable habitats for the pests even if the original *Serissa* host is not available outdoors throughout the year (Anon., 2003a; Anon., 2003b). Fungi often need specific humidity and temperature ranges to infect (Agrios, 1997; Van der Plank, 1963), so while indoor plants may be in highly suitable environments for fungal infection, the chances of fungal spores reaching outdoor suitable habitats are lessened. When the preferred indoor growth of *Serissa* is considered, the risk rating for the fungi remains Medium (2).

The warmer habitat preferred by *T. palmi* may not be met in exterior situations (Lewis, 1997), so establishment of populations outside of greenhouses and interiorscapes is unlikely for most of the territorial United States (Capinera, 2000; Tsai *et al*., 1995). The rating for *T. palmi* is Low (1).

<u>Risk Element 6, subelement 6: Contact with Host Material</u>
Lack of suitable hosts restricts the opportunities for pests to establish populations. While passive factors such as wind, water, or animals may aid in the dispersal of stages of the insect pests (Kosztarab and Kozar, 1988; Rosen, 1990), suitable hosts must be available to sustain a pest population over time. Plants grown in indoor residential areas are likely to be widely separated from native host plant populations, but the close proximity of outdoor plant populations to host material provides a pathway for pests to become established (Beardsley and Gonzalez, 1975). The numbers and types of hosts available to the pest, therefore, becomes a limiting factor for pests with a small host range, such as *M. serissicola*, which is rated Low (1). For *T. palmi*, contacting hosts also will require escape from the indoor setting and finding mates. Low population densities tend to produce only male offspring (arrhenotoky) leading to overall population decline (Lewis, 1997) so this pest is rated Low (1).

Reduced dispersal capability will limit the contact with host material for the nematodes (*Tylenchorhynchus crassicaudatus*, *T. leviterminalis* and *X. brasiliense*), and because many of their hosts are not typically grown indoors in the United States, contacting hosts will require escape from the indoor setting and subsequently finding a host. These pests are rated Medium (2).

The mollusks (*Sarasinula plebeia* and *Succinea horticola*) are rated High (3) because they are non-specific feeders (Robinson, 2003). The remaining pests, *Phomopsis* sp., *R. hibisci* and *Sympiezomias velatus*, are rated High (3) because they are more likely than the nematodes to establish indoor populations on ornamental plants and subsequently escape outdoors.

Table 6. Risk Ratings for the Likelihood of Introduction[1].

Pest	Quantity Imported Annually	Survive postharvest treatment	Survive shipment	Not detected at port of entry	Moved to a suitable habitat	Find suitable hosts	Risk Rating
Sympiezomias velatus	Medium (2)	High (3)	High (3)	Medium (2)	Medium (2)	High (3)	High (15)
Rhizoecus hibisci	Medium (2)	High (3)	High (3)	High (3)	Medium (2)	High (3)	High (16)
Thrips palmi	Medium (2)	High (3)	High (3)	Medium (2)	Low (1)	Low (1)	Medium (12)
Sarasinula plebeia *Succinea horticola*	Medium (2)	High (3)	High (3)	High (3)	Medium (2)	High (3)	High (16)
Melampsora serissicola *Phomopsis* sp.	Medium (2)	High (3)	High (3)	Medium (2)	Medium (2)	Low (1) High (3)	Medium (13) High (15)

Tylenchorhynchus crassicaudatus *T. leviterminalis* *Xiphinema brasiliense*	Medium (2)	High (3)	High (3)	High (3)	Medium (2)	Medium (2)	High (15)

[1]Individual ratings are presented when there is variability within a risk element, otherwise a single rating applies to all the pest organisms for that risk element.

F. Conclusion: Pest Risk Potential

The summation of the values for the Consequences of Introduction and the Likelihood of Introduction is the value for the Pest Risk Potential (Table 7). The following scale is used to interpret this total: Low is 11-18 points, Medium is 19-26 points and High is 27-33 points. This is an estimate of the risks associated with this importation, and reduction of risk occurs through the use of mitigation measures.

Table 7. Values for the Consequences of Introduction, the Likelihood of Introduction and the Pest Risk Potential.

Pest	Consequences of Introduction	Likelihood of Introduction	Pest Risk Potential
Sympiezomias velatus *Rhizoecus hibisci* *Thrips palmi*	High (13) Medium (12) High (14)	High (15) High (16) Medium (12)	High (28) High (28) Medium (26)
Sarasinula plebeia *Succinea horticola*	High (14)	High (16)	High (30)
Melampsora serissicola *Phomopsis* sp.	Low (8) Medium (12)	Medium (13) High (15)	Medium (21) High (27)
Tylenchorhynchus crassicaudatus *T. leviterminalis* *Xiphinema brasiliense*	Low (8) Medium (10) Medium (10)	High (15)	Medium (23) Medium (25) Medium (25)

The Pest Risk Potential for the weevil (*Sympeizomias velatus*), the root attacking mealybug (*Rhizoecus hibisci*) and both mollusk pests (*Sarasinula plebeia* and *Succinea horticola*) is High. The Pest Risk Potential for *Phomopsis* sp. is High and the remaining pathogens, including the nematode pests, are Medium. The Pest Risk Potential for *Thrips palmi* is Medium. Pests with a Low Pest Risk Potential typically do not require mitigation measures other than port of arrival inspection. Specific phytosanitary measures may be necessary for pests rated Medium, and specific phytosanitary measures are strongly recommended for pests with a High Pest Risk Potential.

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